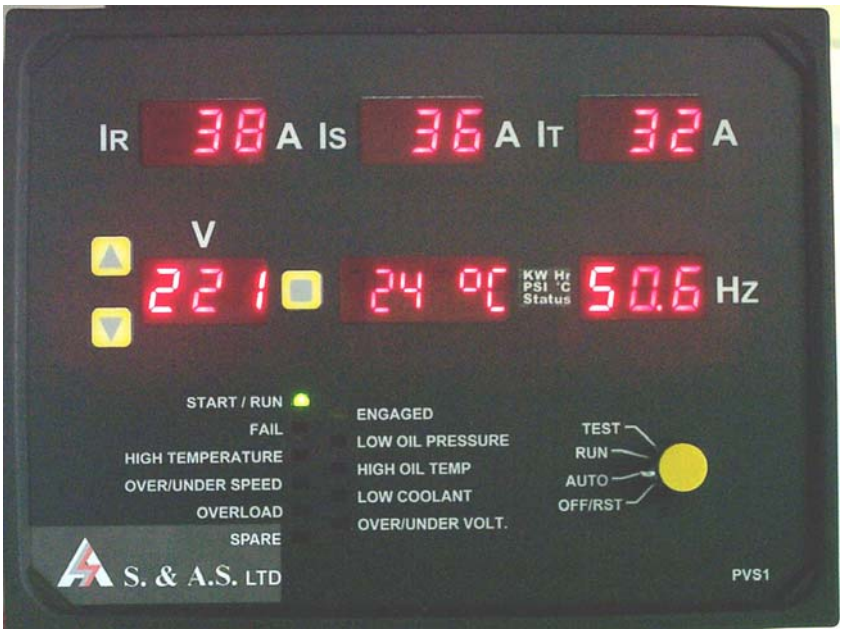
S. & A.S. LTD

AUTO START / INSTRUMENTATION
GENERATOR CONTROL MODULE – PVS1



USER'S MANUAL

FOR H/W VERSION 1.34
FOR S/W VERSION 2.30
0846

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1 INTRODUCTION

This module is the first in a new generation of smart microcontroller based, integrated and low cost generating set controllers. It features enhanced automatic starting and stopping, protection of both engine and generator in addition to instrumentation. A four-position selector provides multiple operating modes: OFF/RESET, AUTO, RUN and TEST. Front panel leds signal the genset status in addition to the faults. The instrumentation interface consists of six 7-segments led displays, size 0.4" and is used to display the currents on the three phases, the voltage and the frequency simultaneously. The fifth display is multifunction and is used to display the active power in KW, the hour meter, the oil pressure, the engine temperature, the genset status, the battery voltage and the fault log. Three front panel push buttons are provided to select the voltage, to access a menu of parameters, to view the last fault with its correspondent readings and to switch to measured values to be displayed on the multifunction display. The menu gives access to all timers, set points and other parameters relevant to the control and protection of the genset. This module can be remotely monitored via connection to Ethernet, a line modem or a GSM modem.

2 FEATURES

- Microcontroller based design
- Operation by a 4-position selector switch
- Easy to fit DIN standard 196x144 panel mount housing
- Connection is via locking plug and socket connectors
- Three dedicated current displays for the three lines
- Dedicated voltage display with push buttons to scroll down all six voltages
- Dedicated frequency display
- Multifunction 6-digits 7-segment display
- Front panel leds for status and alarm indication
- Automatic engine starting and stopping
- Automatic shutdown on fault condition
- Magnetic pick-up input for measuring frequency
- Coolant level sensing by an ac current to avoid electrolysis of the radiator probe
- Menu to provide access to all timers, set points and other parameters
- Over / Under speed alarm and shut down
- Over / Under voltage alarm and shut down
- Overload alarm and shut down
- Low oil pressure pre-alarm
- Low oil pressure alarm and shut down
- High temperature pre-alarm
- High temperature alarm and shut down
- High / Low battery voltage alarm and shut down
- Lamp (led) test by pressing both Up and Down buttons

3 OPERATION

Four operating modes are provided:

- **OFF/RESET**: In this mode the module is completely off and no current is drawn from the battery. If the engine was running prior to switching to this mode, it will be shut down along with the load contactor immediately.
- **RUN**: In this mode the module starts the engine and engages the load after warm-up delay. If this mode is selected after **TEST** mode, the module re-engages the load after warm-up delay.
- **TEST**: Load contactor is released immediately and the genset is kept running at no load. Of course, switching to this mode from **OFF/RESET** will prompt the module to start the genset and run it at no load.
- **AUTO**: The module starts the genset after a response delay[1] if a start signal is received on the remote control input. Load is engaged after the elapse of the warm-up delay[2]. When the start signal is removed, the load contactor is released after an off delay[3] and the genset is shut down after the elapse of the cooling time[4].

[1] Response delay is set by selecting item A01 in the menu. Refer to section 6.
[2] Warm-up delay is set by selecting item A07 in the menu. Refer to section 6.
[3] Off delay is set by selecting item A08 in the menu. Refer to section 6.
[4] Cooling time is set by selecting item A09 in the menu. Refer to section 6.

Crank disconnect is exclusively based on the frequency if the magnetic pick-up is installed. The frequency set point used to stop cranking is set by item A12 in the menu; refer to section 6. On the other hand, if the magnetic pick-up is not installed, crank disconnect is based on the oil pressure switch as well as the generator frequency. Furthermore, only the frequency display remains on during cranking.

The displays remain on as long as the engine is running. When the engine stops all displays will go off after a delay of 25 sec to preserve battery power.

4 VIEWING FAULTS AND FAULTS DESCRIPTION

4.1 HOW TO VIEW THE FAULTS

Pressing the **Enter** push button while "FLtLog" is displayed on the multifunction display will prompt the **PVS1** to start displaying the last 10 faults saved in memory. The PVS1 begins by displaying the last fault on the multifunction display. Press **Previous** or **Next** push buttons to display the previous or next fault. To view the voltage, current, frequency and other parameters of the multifunction display saved when the fault has occurred, press **Enter**. **Previous** or **Next** will scroll down the parameter displayed on the multifunction display. When **Enter** is pressed again, all the displays return to their actual reading and the multifunction display shows the fault code. To exit the fault log, Press **Previous** or **Next** until "NoErr" is displayed.

4.2 HOW TO ERASE THE FAULTS

To erase the faults, enter the menu, go to A36 and press **Enter** push button. You will be prompted to confirm your request. If **Enter** is pressed all faults are erased, if **Previous** or **Next** are pressed, faults will not be affected.

5 FRONT PANEL DESCRIPTION

5.1 MEASURED AND DISPLAYED PARAMETERS

- The currents on the three phases are measured and displayed simultaneously.
- The line-neutral and line-line voltages are all measured. The voltage displayed is selected by the up and down push buttons.
- The frequency[1] is measured and permanently displayed.
- The active power in KW is measured and displayed on the multifunction display.
- The hour counter is updated and displayed on the multifunction display.
- The oil pressure is measured and displayed on the multifunction display.
- The engine temperature is measured and displayed on the multifunction display.
- The battery voltage is measured and displayed on the multifunction display.
- A fault description is showed on the multifunction display upon the occurrence of any fault.

Pushing the increase and decrease push buttons simultaneously activates a lamp test and switches their function between the voltage display and the multifunction display.

5.2 FRONT PANEL LEDS

- Start / run: ON indicates reception of a starting command. Blinking indicates that the engine is running
- Engaged
- Fail: ON indicates a failure to start or a magnetic pick-up failure. Blinking indicates an emergency stop, a high battery voltage or a low battery voltage.
- Low oil pressure
- High temperature
- High oil temperature
- Over/under speed (led blinks for over speed and remains ON for under speed)
- Low coolant
- Overload
- Over/under voltage (led blinks for over voltage and remains ON for under voltage)
- Spare 2/Spare 1

[1] The frequency is based on the RPM read from the magnetic pick-up if installed; otherwise it will be based on the generator output voltage.

5.3 DETECTED AND SIGNALED FAULTS

Fault	ALARM RELAY	SHUT DOWN	Comments
Fail to start	✓	✓	Fail led ON
Emergency stop	✓	✓	Fail led blinking
High battery voltage	✓	✓	Shuts load and engine after high battery voltage delay.
Low battery voltage	✓	✓	Shuts load and engine after low battery voltage delay.
Magnetic pick-up	✓	✓	Fail led ON
Low oil Pressure	✓	✓	Immediate visual alarm. Shuts load and engine down 5 sec after alarm
High Temperature	✓	✓	Immediate visual alarm. Shuts load 4 sec after alarm and engine after cooling[1]
High oil Temperature	✓	✓	Immediate visual alarm. Shuts load 4 sec after alarm and engine after cooling[2]
Over/Under speed	✓	✓	Immediate visual alarm. Shuts load and engine down after 1.5/5 sec delay[3]
Low Coolant Level	✓	✓	Shuts load and engine down 4 sec after alarm
Over/Under Voltage	✓	✓	Immediate visual alarm. Shuts load and engine down after 3/5 sec delay[4]
Overload	✓	✓	Immediate visual alarm. Shuts load after overload delay. Shuts engine after cooling[5]
Spare1	✓	✓	Immediate visual alarm. Shuts load and engine down 4 sec after alarm. Spare led ON
Spare2	✓	✓	Immediate visual alarm. Shuts load and engine down 4 sec after alarm. Spare led blinking

5.4 DESCRIPTION OF STATUS MESSAGES SHOWN ON MULTIFUNCTION DISPLAY

Status Message	Description
Rdy	Genset ready
rtS	Request to start with countdown of response delay
PHt	Preheating with countdown of preheating delay
CrA	Cranking
Run	Engine running with countdown until load is engaged
rLd	Engine running on load
SLd	Counting down off delay time to disconnect the load
SEg	Counting down cooling time to shut down the engine
StFAiL	Fail to start
LoOiLP	Low oil pressure
Hi °C	High temperature
S1FAiL	Spare1 fail
S2FAiL	Spare2 fail
HiUoLt	Overvoltage
LoUoLt	Undervoltage
HiFrEq	Overspeed
LoFrEq	Underspeed
HiLoAd	Overload
HiOiLt	High oil temperature
PiFAiL	Magnetic pick-up fail
LoCooL	Low coolant level
E StoP	Emergency stop
Hi bAt	High battery voltage
Lo bAt	Low battery voltage

[1] If A20 is not set to zero. Otherwise, engine is shut with alarm.
[2] If A20 is not set to zero. Otherwise, engine is shut with alarm.
[3] If either A10 or A11 parameter is set to zero its correspondent alarm is disabled.
[4] If either A13 or A14 parameter is set to zero its correspondent alarm is disabled.
[5] If A20 is not set to zero. Otherwise, engine is shut with alarm.

6 REAR PANEL DESCRIPTION

6.1 TERMINAL DESCRIPTION

The following tables summarize the terminals functions of each of the 7 connectors.

CONNECTOR						
TERMINAL	P1			P2		
	1	-VBAT SUP	-ve battery supply	7	ALARM NC	Output for alarm normally closed
	2	+VBAT SUP	+ve battery supply	8	ALARM NO	Output for alarm normally opened
	3	PRE HEAT	Output for preheating resistor	9	COIL C	Output for load contactor common
	4	ELEC. VALVE	Output for fuel electric valve	10	COIL NO	Output for load contactor normally opened
	5	START	Output for starter	11	TRIP C	Spare output common
	6	ALARM C	Output for alarm common	12	TRIP NO	Spare output normally opened

CONNECTOR						
TERMINAL	P3			P4		
	13	DYNA EXCT	Dynamo excitation output	19	SPARE 1	Spare 1 input
	14	+VBAT POWER	After emergency stop and fuse	20	SPARE 2	Spare 2 input
	15	RMTE CNRL	Remote control input	21	NOT USED	Not used
	16	OPS	Oil pressure switch input	22	COOL PROBE	Radiator coolant level sensing probe
	17	ETS	Engine temperature switch input	23	PICK UP-	Magnetic pick-up –ve input
	18	OTS	Oil temperature switch input	24	PICK UP+	Magnetic pick-up +ve input

CONNECTOR						
TERMINAL	P5			P6		
	25	CT R P1	Current transformer on line R – p1	31	LINE R	Line R input
	26	CT R P2	Current transformer on line R – p2	32	NOT USED	Not used
	27	CT S P1	Current transformer on line S – p1	33	LINE S	Line S input
	28	CT S P2	Current transformer on line S – p2	34	NOT USED	Not used
	29	CT T P1	Current transformer on line T – p1	35	LINE T	Line T input
	30	CT T P2	Current transformer on line T – p2	36	N	Neutral input

CONNECTOR			
TERMINAL	P7		
	37	ET SENS	Engine temperature sensor input
	38	OP SENS	Oil pressure sensor input
	39	COM	Sensors common input

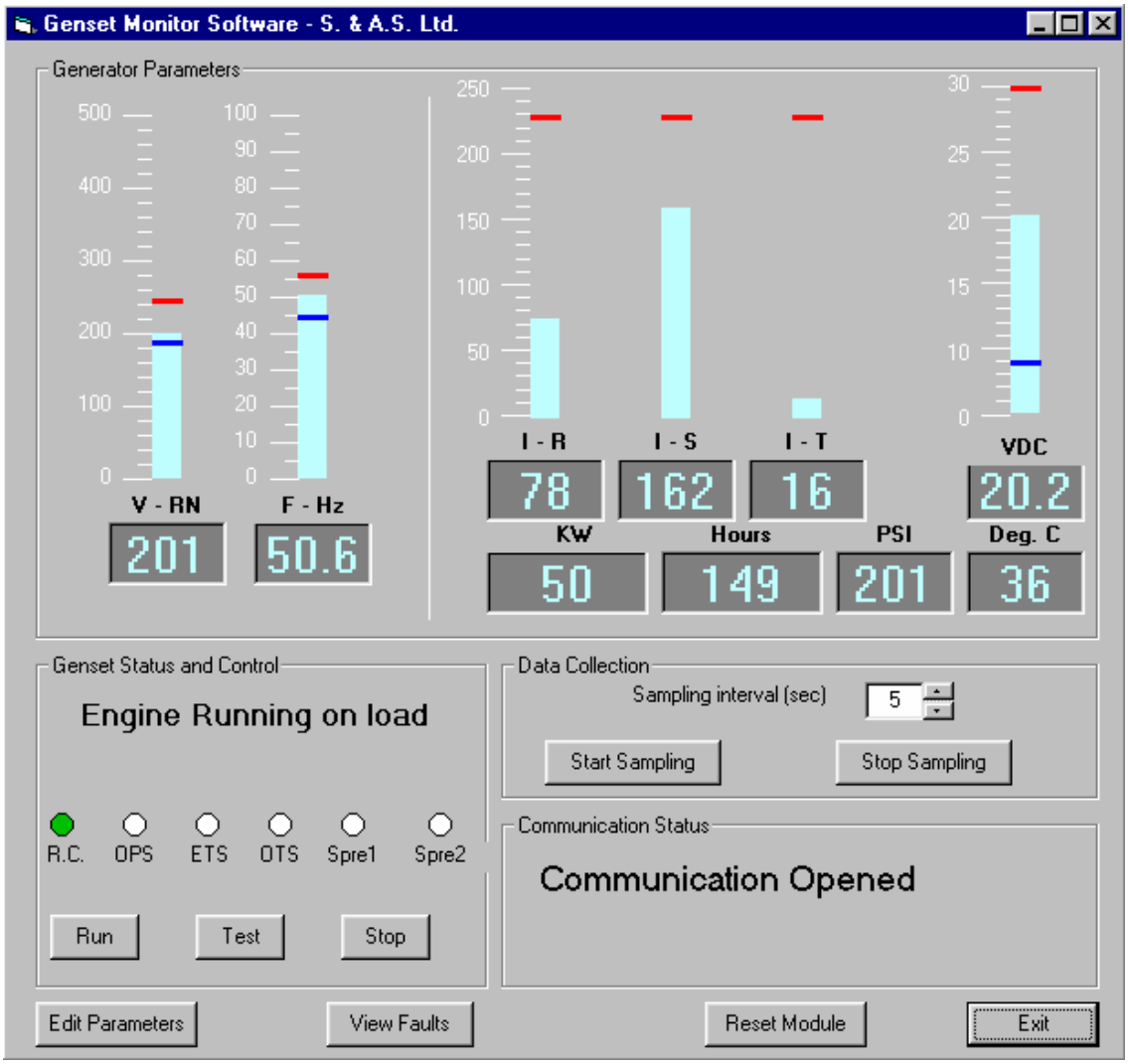
6.2 LEDS DESCRIPTION

The rear panel leds signal the status of the digital inputs:

Led No.	Color	Correspondent input
1	Green	Remote control input
2	Red	Oil pressure switch input
3	Red	Engine temperature switch input
4	Red	Oil temperature switch input
5	Red	Spare 1 input
6	Red	Spare 2 input

7 FEATURES SUPPORTED BY DIRECT RS232, MODEM CONNECTION OR ETHERNET

Through direct RS232 to a PC, a line modem, a GSM modem or an Ethernet connection, the user will be connected to the PVS1. When connection is established, the following window appears:



The user will be able to view the following:

1. Selected voltage.
2. Frequency.
3. Three phases' currents.
4. Oil pressure.
5. Temperature.
6. Battery voltage.
7. Power in KW.
8. Hour meter.
9. Over/under voltage set point.
10. Over/under frequency set point.
11. Overload set point.
12. Over/under battery voltage set point.
13. Generator status.
14. Communication status.
15. The 10 recent faults with all their corresponding readings by pressing the "View Faults" button.

In addition to the above, the user has access to the following:

1. Run the PVS1 with or without load by pressing “Run” or “Test” button.
2. Stop the PVS1 by pressing “Stop” button. This button cancels the Run/Test order.
3. Clear the fault log by pressing "Erase Faults" button in the “View Faults” window.
4. View and modify the parameters using "Edit Parameters".
5. Reset the PVS1 module by pressing "Reset Module" button.
6. Collect data with a fixed sampling interval by pressing “Start Sampling” button.

7.1 SETTING UP THE PVS1 FOR GSM MODEM

Please set the following parameters to be able to use the GSM modem:

1. The identification of the PVS1 module: This ID will be included as a header of all sent or received SMS messages. It must contain 6 digits which can be numbers (from 0 to 9) combined with the following letters: a, b, c, d, e, f, h, i, l, n, o, p, q, r, s, t, u, y (upper or lower case, e.g. SASt09). Any message with a wrong ID will be ignored.
2. The phone number: When a fault occurs, The PVS1 will send an SMS containing as a header the PVS1 ID followed by the fault description and all the readings at the time the fault occurred. This SMS is sent to the phone number specified by the user. The phone number must be between 3 to 18 digits long.

Following is a description of the functions supported via SMS:

Reset	PVS1 ###### reset[1]
Run	PVS1 ###### run
Test	PVS1 ###### test
Stop	PVS1 ###### stop
View all the readings	PVS1 ###### measure
Modify the	PVS1 ###### modify A01=5,A03=32,A12=145,A30=0,A10=23[2]
View the parameters	PVS1 ###### request A01,A03,A12,A30,A10[3]

[1] ###### being the ID number.
[2] A maximum of five parameters can be modified in the same message. All parameters are accessible except the ID, the phone number, the hour meter and the PC/Modem/GSM modem selection.
[3] A maximum of five parameters can be requested in the same message.

7.2 SETTING UP THE PVS1 FOR ETHERNET

How to set the PVS1 IP address:

- ✓ Enter the menu (Refer to PVS1 v1.34 manual, section 8)
- ✓ Go to item labeled A33:
  - ➢ If dynamic IP is used, enter the digit “1” followed by the digit “b”(e.g. 1b)
  - ➢ If fixed IP is used, enter the digit “0” followed by 12 digits representing the IP address .Then enter the subnet mask which is a two digit number followed with the digit ”b” (e.g. 019216800002408b)
  - ➢ Go to A34 (optional) to enter a name that refers to the site where the PVS1 is installed.

8 MENU DESCRIPTION

Follow the steps described below to access the menu:

1. While module is powered, press the ENTER push button once. You will be prompted to enter a three-digit code on the voltage display. Display shows “E“ on the leftmost digit.
2. Use the UP and DOWN push buttons to scroll to the desired number.
3. Press the ENTER push button. “c” replaces the first digit. “E” is displayed on the middle digit.
4. Use the UP and DOWN push buttons to scroll to the desired number.
5. Press the ENTER push button. “c” replaces the middle digit. “E” is displayed on the rightmost digit.
6. Use the UP and DOWN push buttons to scroll to the desired number. Press the ENTER push button.

If the entered password is valid, the user will have access to the menu below. If no push buttons are pressed for 25 sec while in the menu, the system will automatically exit the menu.

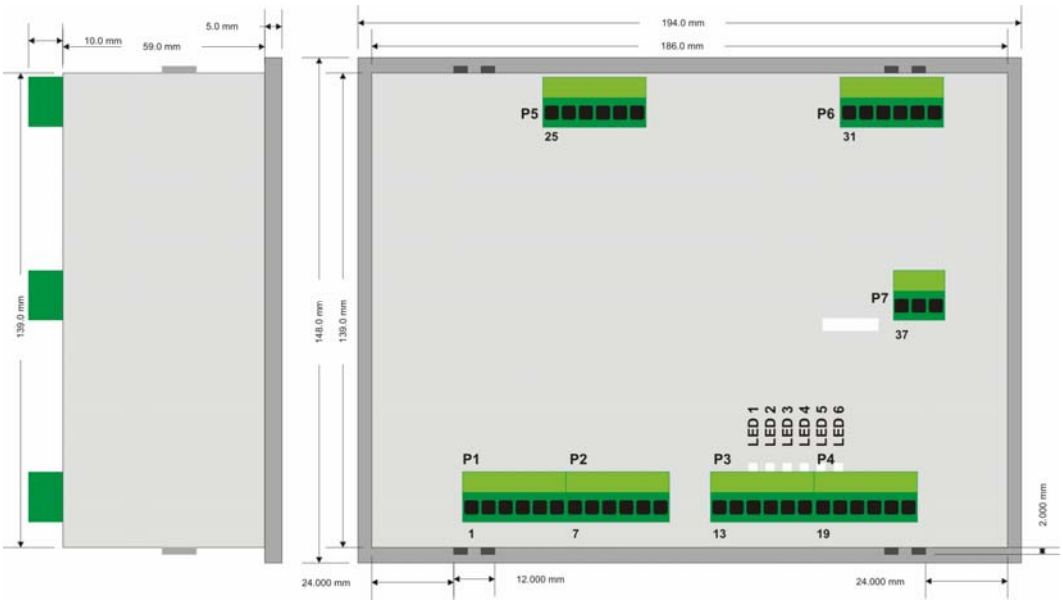
Display	Parameter description	Range	Factory setting
A01	Response delay	0 to 255sec	5 sec
A02	Pre-heater time	0 to 255sec	0 sec
A03	Starter time	0 to 255sec	5 sec
A04	Time between trials	0 to 255sec	12 sec
A05	Number of attempts	0 to 255	3
A06	Fault bypass delay	0 to 255sec	15 sec
A07	Engine warm-up time	0 to 255sec	10 sec
A08	Off delay time	0 to 255sec	10 sec
A09	Engine cooling time	0 to 255sec	5 sec
A10	Over frequency set point	0 to 255Hz	55Hz
A11	Under frequency set point	0 to 255Hz	45Hz
A12	Crank disconnect frequency	0 to 255Hz	15Hz
A13	Over voltage set point	0 to 255V	240V
A14	Under voltage set point	0 to 255V	200V
A15	Current transformer ratio /10	0 to 255	10
A16	Overload in % of current transformer	0 to 255	90
A17	Overload delay	0 to 255sec	10 sec
A18	Flywheel count of teeth per revolution	0 =magnetic pick-up not installed 1-255= enables magnetic pick-up and sets the flywheel count of teeth	0
A19	Coolant level float switch / Spare 1 input logic	0=nc/nc 1=nc/no 2=no/nc 3=no/no	3
A20	Cooling after high temperature, high oil temperature and overload alarm	0=no cooling before shutdown 1-255= cooling before shutdown	1
A21	Oil pressure sensor type	0=VDO 1=ECHLIN 2=MURPHY	0
A22	Engine temperature sensor type	0=VDO-1 1=VDO-2 2=MURPHY	0
A23	Oil pressure bypass delay for crank disconnect/10	0 to 255	0.0sec
A24	Low oil pressure pre-alarm set point	0=disabled 1 to 255psi	0
A25	Low oil pressure shut down set point	0=disabled 1 to 255psi	0
A26	High temperature pre-alarm set point	0=disabled 1 to 255degreeC	0
A27	High temperature shut down set point	0=disabled 1 to 255degreeC	0
A28	High battery set point	0 to 255V	30V
A29	Low battery set point	0 to 255V	8V
A30	High battery delay	0 to 255sec	3sec
A31	Low battery delay	0 to 255sec	2sec
A32	Regular Modem/GSM/PC selection	0 for Regular Modem/ 1 for GSM/ 2 to 255 for PC	255
A33	Phone number	3 to 18 digits long	000000000000000000
A34	PVS1 ID	######	SAStSt
A35	Modify hour meter	0 to 99999	0
A36	Erase Faults	N/A	N/A
A37	Exit Menu	N/A	N/A

9 TECHNICAL SPECIFICATION

Supply voltage range	5 to 33Vdc
Maximum supply current	550mA on 12Vdc – 275mA on 24Vdc
Standby supply current[1]	60mA on 12Vdc – 30mA on 24Vdc
Digital inputs activation logic	Low (ground)
Output relays rating	10A 250V ac1
AC inputs range (L-N)	0 to 280Vac
CT inputs range	0 to 5Amps
Operating temperature	-30 to 70°C
User access	Three touch buttons
Data sampling rate	0.8 samples/sec
Dimensions	192x144x78

[1] In AUTO mode with genset in standby and waiting for a start signal.

10 CASE DIMENSIONS



11 TYPICAL WIRING DIAGRAM